

WaterSense® Notice of Intent (NOI) to Develop a Draft Specification for Pool Covers

I. Introduction

Evaporation from swimming pools contributes to water waste and, in the case of heated pools, energy waste. Pool owners can use pool covers to prevent evaporation, reducing the amount of water that needs to be added to the pool to maintain the water level. Pool covers can be used on residential, commercial, and institutional pools of almost all sizes and shapes. Pool covers can also help keep debris out of the pool, reducing the need to conduct maintenance and operate pool equipment, such as pool filters and pool pumps, further contributing to energy savings. Reductions in pool filtering can contribute to additional water savings through a reduction in filter backwashing (Koeller and Company and Hoffman and Associates 2010¹).

Pool covers that can reduce evaporation of pool water are readily available on the market nationwide. To help heighten consumer and utility awareness about the potential to reduce water waste through use of pool covers, WaterSense is considering developing a specification to label this product category. With this Notice of Intent (NOI), WaterSense has preliminarily identified the water efficiency and performance criteria that it is considering, as well as data gaps and outstanding issues that need to be addressed for the program to move forward in developing a draft specification for pool covers.

WaterSense typically labels products that are at least 20 percent more water-efficient, perform as well as or better than standard models, and can realize water savings on a national level. WaterSense and its partners also work to promote the adoption of water-efficient best practices. A WaterSense label on pool covers could help promote these products as an easy, effective way to save water in residential and commercial pools. There are approximately 8.5 million existing pools (in-ground and above-ground) installed in residences and more than 240,000 pools installed in commercial locations across the United States² (P.K. Data 2016A³). The U.S. Environmental Protection Agency (EPA) estimates that a typical, residential pool in the United States can lose between 12,000 and 31,000 gallons of water to evaporation every year.

II. Technical Background

All pools experience evaporation. The magnitude of water loss is strongly correlated to the size of the pool water surface and its exposure to climactic factors, such as wind, sunlight, temperature, and humidity. Pool covers can be used on indoor and outdoor, in-ground and above-ground pools of almost any size or shape, in almost any setting (e.g., residential, commercial).

Pool owners select a pool cover based on a mix of factors. These factors include swimmers' use habits and needs, safety requirements, local climate, pool size and type (e.g., in-ground or

¹ Koeller and Company and H.W. (Bill) Hoffman and Associates. "Evaluation of Potential Best Management Practices - Pools, Spas, and Fountains." *The California Urban Water Conservation Council*, September 2010. cuwcc.org/LinkClick.aspx?fileticket=3p3DgiY6ObY%3D.

² Contiguous 48 states and the District of Columbia.

³ "U.S. Swimming Pool and Hot Tub Market 2015." *APSP.org. The Association of Pool and Spa Professionals (APSP)*, P.K. Data, Inc. 2016. Web. <http://www.apsp.org/Portals/0/2016%20Website%20Changes/2015%20Industry%20Stats/2015%20Industry%20Stats.pdf>.

above-ground), household budget, landscape setting, and aesthetics. Pool owners also select pool covers based on the different functionalities covers can provide, as different designs and styles serve different purposes.

Typically, a pool owner may purchase up to two different pool covers for their pool: a pool cover used when the pool is open for swimming, usually in the summer, and another pool cover used when the pool is closed for extended periods, usually in the winter. Winter covers are primarily intended to protect the pool structure and pool equipment as well as capture debris before it falls into the pool. They are not intended to make contributions to water savings through reduced evaporation, since they're consistently applied throughout winter months when evaporation is reduced. Conversely, pool covers intended for daily use during the open season can, when consistently applied, make significant contributions to reducing or even eliminating pool water evaporation in the hottest months of the year. Generally, pool covers are intended to retain pool water in the pool and minimize or eliminate debris and precipitation falling into the pool. The ability of an individual pool cover to achieve these objectives is partially impacted by its material grade and design.

Solid, mesh, and hybrid covers are the most common types of pool cover material grade. Pool owners may select cover material grade based on a combination of factors centered around pool use patterns and pool needs. Solid pool covers will prevent all debris (e.g., leaves, branches, dust) and precipitation from accessing the pool water, reducing cleaning needs. But, if the pool is closed for an extended period of time, a pool cover pump may be needed to prevent precipitation from pooling on the cover, which can create a safety hazard or damage the cover from the excess weight. Mesh covers allow some precipitation and fine debris (e.g., dust) to pass through, are light-weight, and eliminate the need for a pool cover pump; however, they are less effective at reducing evaporation. Hybrid covers, which are solid on the perimeter and mesh in the center, also eliminate the need for a cover pump and are lighter in weight than solid covers. Mesh and hybrid covers typically increase the amount of cleaning needed compared to solid covers (Swim University 2017A⁴).

Insulative solar covers trap heat from the sun in the pool water to save energy. Solar energy or thermal blankets, sometimes called "bubble covers," are tarp-like insulative sheets that cover the entire pool water surface. Alternatively, solar rings are lightweight, solid discs that may link together on the pool surface via magnets to form a patchwork solar cover. While solar ring sets may cover a majority of the pool water surface, a portion of this surface usually remains exposed (CalPoly 2016⁵; Swim University 2017B⁶).

Liquid covers, also called liquid evaporation suppressants (LESs), are non-toxic, chemical, ultra-thin films (approximately 2.0×10^{-6} mm) dispersed on the water surface to reduce evaporation (CalPoly 2016⁷). LESs are primarily used in commercial pools that have extended hours of daily use and allow swimmers to use the pool while the cover is applied. While contributing to

⁴ Loop-Loc, Ltd. "Pool Safety Covers: How to Choose the Right One." *Swim University*. Ace Media, LLC., 8 Aug. 2017. Web. <https://www.swimuniversity.com/pool-safety-covers>

⁵ Muleta, Misgana. "Cal Poly Study: Effectiveness of Pool Covers to Reduce Evaporation from Swimming Pools." *National Plasterers Council (NPC)*, 2016, www.npconline.org/?page=cal_poly_study.

⁶ "The Complete Guide to Solar Pool Covers." *Swim University*. Ace Media, LLC., 5 July 2017. Web. <https://www.swimuniversity.com/solar-pool-covers/>

⁷ CalPoly, *op. cit.*

reduced evaporation, they do not prevent debris or additional precipitation from falling into the pool.

Pool covers can also be certified as safety pool covers to protect children and animals from drowning. Such covers meet the safety requirements established in ASTM International's (ASTM) *Standard Performance Specification for Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas, and Hot Tubs: F1346-91* (ASTM F1346-91) (ASTM 2018⁸). See **Performance and Product Testing** for more details.

Pool covers can be automatically, semi-automatically, or manually controlled. Manually controlled pool covers (manual covers) must be applied and removed by hand, often by either folding the sheet and storing it out of the way or by hand-feeding a hand-cranked reel to roll up the cover; this reel may be portable or fixed. The cover may be guided onto and off the reel by hand or by pull-cords. Manual covers may float freely on the water surface (often called floating covers) or may be affixed to the pool surface by top-mounted tracks or anchors embedded in the decking around the perimeter of the pool (CalPoly 2016⁹; DOE 2018¹⁰).

Semi-automatically controlled pool covers (semi-automatic covers) utilize a motor-driven reel to extend or retract the cover but still require the user to guide the cover onto and off the reel during (un)rolling by hand or with pull-cords. The reel may be affixed to the pool deck or may be portable. The covers are often guided by top-mounted or embedded tracks along the perimeter of the pool (CalPoly 2016¹¹; DOE 2018¹²).

Automatically controlled pool covers (automatic covers) have push-button activated, permanently mounted, motor-driven reels and always utilize tracks mounted in or on the pool deck to guide the cover over the water surface of in-ground pools (CalPoly 2016¹³; DOE 2018¹⁴).

In the United States, there are a wide variety of codes, regulations, and performance standards, both mandatory and voluntary, pertaining to swimming pool construction, maintenance, and operation. However, few pertain to or specifically require the use of pool covers. Currently, none specifically assess a pool cover's ability to prevent evaporation, the primary water savings mechanism of a pool cover.

WaterSense has identified a nationally applicable standard and a test method that pertain to pool covers and their use.

⁸ ASTM International (ASTM) Standard F1346 - 91(2018), Standard Performance Specification for Safety Covers and Labeling Requirements for All Covers for Swimming Pools, Spas and Hot Tubs. *ASTM International*. February 2018, DOI: 10.1520/F1346-91R10 <https://www.astm.org/Standards/F1346.htm>

⁹ CalPoly, *op. cit.*

¹⁰ "Swimming Pool Covers." *Energy.gov*, U.S. Department of Energy, 2018, www.energy.gov/energysaver/swimming-pool-covers.

¹¹ CalPoly, *op. cit.*

¹² DOE, *op. cit.*

¹³ CalPoly, *op. cit.*

¹⁴ DOE, *op. cit.*

- As mentioned, *ASTM F1346-91* sets performance requirements for certifying safety covers in the United States but also defines types of pool covers and prescribes labeling requirements for all pool covers (ASTM 2018¹⁵).
- Australia's *Smart WaterMark*® program stipulates within its *Guidelines for Pool Cover Applications* that water savings from pool covers must be calculated using ASTM *E96/E96M – 16 Standard Test Methods for Water Vapor Transmission of Materials (ASTM E96)*. See **Water Efficiency** for more details on this test method (ASTM 2016¹⁶).

WaterSense has also identified a multitude of national and international, mandatory and voluntary, codes pertaining to the efficient and safe operation of pools and, in some cases, pool covers. Four of the most prominent codes make explicit requirements for certain pools to be covered with a “vapor retardant cover.” However, none of the codes define the term “vapor retardant” or stipulate efficiency or performance requirements for covers.

- *ANSI/APSP/ICC-13-2017 Standard for Water Conservation Efficiency in Pools, Spas, Portable Spas, and Swim Spas (APSP-13)* prescribes technologies to increase water efficiency and conservation in both new and existing residential and public pools, including requiring that, “outdoor pools and outdoor permanent spas... be provided with a vapor retardant cover or other vapor retardant” means (The Association of Pool & Spa Professionals (APSP) 2016¹⁷).
- The International Code Council's (ICC) *2018 International Swimming Pool and Spa Code (ISPSC)*, an international code pertaining to swimming pool, hot tub, and spa design, performance, and efficiency, requires heated pools and in-ground spas to be equipped with vapor retardant covers (ICC 2018¹⁸). The *ISPSC* is codified in 11 U.S. states and multiple municipalities (APSP 2017¹⁹).
- The ICC's *2015 International Green Construction Code (IgCC)* requires outdoor heated pools and outdoor permanent spas be provided with a vapor retardant cover or other approved vapor retardant means (ICC 2015²⁰).
- The International Association of Plumbing and Mechanical Officials' (IAPMO) *2017 Water Efficiency and Sanitation Standard (WE•Stand)* makes many requirements for water efficiency within swimming pools and also requires heated pools, in-ground

¹⁵ ASTM 2018, *op. cit.*

¹⁶ “ASTM E96 / E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.” ASTM International, 2016. <https://www.astm.org/Standards/E96>

¹⁷ “APSP-13 Standard for Water Conservation Efficiency in Pools, Spas, Portable Spas and Swim Spas.” *The Association of Pool and Spa Professionals (APSP)*, 2016. www.genesis3.com/text/BSR_APSP-13_ANSI-PUBLIC-REVIEW-082216.pdf.

¹⁸ “2018 ISPSC: International Swimming Pool and Spa Code.” *International Code Council (ICC)*, 2017. <https://codes.iccsafe.org/public/document/ISPSC2018/preface>

¹⁹ “ISPSC Adoption Status Report” *The Association of Pool and Spa Professionals (APSP)* 2017. <http://www.apsp.org/LinkClick.aspx?fileticket=4Dj6JniT7hY=&&portalid=0>

²⁰ “2015 IgCC International Green Construction Code: Standard for the Design of High-performance Green Buildings Except Low-rise Residential Buildings.” 1st ed. Country Club Hills, IL: International Code Council (ICC), 2015.

permanently installed spas, and portable spas be equipped with a vapor retardant cover (IAPMO 2017²¹).

There are also a myriad of mandatory and voluntary codes pertaining to swimming pools at the state or municipal level. Some of these codes apply to residential pools and some also cover commercial and institutional pools. A large majority of these codes apply to swimmer safety or energy efficiency of pools, but these requirements can lead to additional water savings. For example, the Texas State Energy Conservation Office enacted the 2016 *Water Conservation Design Standards for State Buildings and Institutions of Higher Education Facilities*, which requires that “pools and spas shall be covered when not in use where practical” (SECO 2016²²). Moreover, in 2015 the California Energy Commission (CEC) enacted Title 24, *Building Energy Efficiency Standards for Residential and Nonresidential Buildings*, which states that any outdoor pool or spa system installed with a heat pump or gas heater must be equipped with a cover (CEC 2015²³).

Currently, the EPA requires the use of pool covers on outdoor pools in the *WaterSense New Home Specification*, Version 1.2 (EPA 2014²⁴) and recommends their use in *WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities* (EPA 2012²⁵).

WaterSense is seeking input on additional standards or test methodologies that assess the potential efficiency and performance of pool covers. WaterSense is also seeking input on additional standards and codes that require pool covers or incorporate water efficiency requirements of pool covers.

III. Existing Studies on Water Efficiency of Pool Covers

To date, WaterSense has only identified one laboratory study specifically gauging pool cover water efficiency. In 2016, California Polytechnic State University (CalPoly²⁶) conducted a study at The National Pool Industry Research Center (NPIRC) that evaluated the evaporation suppression efficiency of:

- Three types of manual pool covers:
 - a solid track cover with a hand-cranked reel
 - a floating foam cover
 - a floating bubble cover

²¹ International Association of Plumbing and Mechanical Officials (IAPMO). *Water Efficiency and Sanitation Standard (WE•Stand)*. 1st ed. 2017.

²² Texas Comptroller of Public Accountants, State Energy Conservation Office (SECO). *Water Conservation Design Standards*. Austin, Texas. 2016.
<https://comptroller.texas.gov/programs/seco/docs/water-conservation-design-standards.pdf>

²³ California Energy Commission (CEC). *Building Energy Efficiency Standards for Residential and Non-Residential Buildings (CEC-400-2015-037-CMF)*. June 2015.
<http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf>

²⁴ U.S. Environmental Protection Agency. Office of Water. *WaterSense® New Home Specification*. 24 July 2014. <https://www.epa.gov/sites/production/files/2017-01/documents/ws-homes-spec.pdf>.

²⁵ U.S. Environmental Protection Agency. Office of Water. *WaterSense At Work: Best Management Practices for Commercial and Institutional Facilities*. Oct. 2012.
https://www.epa.gov/sites/production/files/2017-02/documents/watersense-at-work_final_508c3.pdf ²⁶

CalPoly, *op. cit.*

- Two types of liquid covers; and
- A set of eight, five-foot diameter solar rings that, when combined, covered 73 percent of the water surface.

All covers were subjected to 83 days of testing while results were controlled for external impacts (e.g., impacts from climate, structural leaks, etc.). These results are summarized in Table 1. The study noted that these efficiency rates may not be representative of efficiencies produced in real-world applications and likely reflect maximum possible efficiencies, as all covers subject to investigation were never removed from the pool except for water level testing and cleaning (CalPoly 2016²⁷).

Table 1. Evaporation Reduction Efficiencies of Pool Covers

| Cover Type | Average Efficiency (%) |
|----------------------------------|------------------------|
| Liquid Evaporation Suppressant A | 14.4 |
| Liquid Evaporation Suppressant B | 15.8 |
| Solid Track Cover | 93.9 |
| Foam Cover | 95.9 |
| Bubble Cover | 94.9 |
| Solar Rings | 50.1 |

Source: CalPoly (2016)²⁸

Although WaterSense has not identified other laboratory studies specifically on the water efficiency of pool covers, some field surveys have gauged adoption and application rates of pool covers to establish a baseline for water loss from swimming pools. For instance, the Water Research Foundation’s 2016 *Residential End Uses of Water Study Version 2.0* (REUWS) determined that:

- During the peak evaporative month, almost 155 gallons of water may be lost every day from a 500 ft² pool (WRF 2016²⁹). For context, this is roughly the average size of a typical in-ground residential pool (Koeller and Company and Hoffman and Associates 2010³⁰).
- 30.1 percent of pool owners reported owning a solid pool cover and 0.4 percent reported owning a chemical (liquid) pool cover.
- 49 percent of these solid pool cover owners reported removing and replacing the cover regularly (e.g., overnight), while 51 percent reported only removing and replacing the cover seasonally.

²⁷ CalPoly, *op. cit.*

²⁸ CalPoly, *op. cit.*

²⁹ DeOreo W., Mayer P., Kiefer J., Dziegielewski B. “Residential End Uses of Water (REUWS) Study Update.” Water Research Foundation (WRF). 2016.

³⁰ Koeller and Company and Hoffman and Associates, *op. cit.*

In 2004, Koeller and Company³¹ surveyed residential pool owners in Southern California and found the average pool use rate to be 5.7 days per week. The survey also found that:

- 62 percent of pool owners reported their cover was always on the pool when not in use;
- 3 percent reported the pool cover is “sometimes” on the pool; and
- 35 percent reported that their cover was not on the pool when not in use.

However, when follow-up, on-site surveys were conducted at these same residences:

- Only 42 percent of covers were actually installed on the pools at the time of the visits; the remaining 58 percent of covers had been purchased but were in storage and not installed on the pool.
- Only 13 of the 38 pool cover owners also owned a reel in addition to a pool cover.

The study concluded that owning a pool cover reel did not appear to impact rates of pool cover application. Of the 12 customers with pool cover reels installed, only five had their covers on the pool (Koeller and Company 2004³²).

WaterSense is seeking input on the application rates of pool covers in real-world scenarios and the possible impact that control mechanisms may have on application rates.

IV. Product Market

As of 2015, there were roughly 8.5 million pools (in-ground and above-ground) installed in the United States. As shown in Figure 1, nearly 75 percent (6.5 million pools) of these pools were housed in just 10 states (P.K. Data 2016A³³). In 2015, the U.S. Energy Information Administration (EIA) administered the *Residential Energy Consumption Survey (RECS)* and gauged pool use frequency. They found that, of 8.4 million pools nationwide, 2.7 million were used for less than three months of the year; 4.8 million were used for four to seven months of the year; and 900,000 were used for more than eight months or year-round (EIA 2017³⁴).

³¹ Koeller and Company. “Swimming Pool Cover Rebate Program: Follow Up Customer Survey,” *MaP-Testing*, May 2004. Web. http://www.map-testing.com/assets/reports/Pool_Covers_Consumer%20survey%202004.pdf.

³² Koeller and Company, *op. cit.*

³³ P.K. Data, Inc. 2016A, *op. cit.*

³⁴ “Residential Energy Consumption Survey (RECS).” *U.S. Department of Energy. U.S. Energy Information Administration (EIA)*, Feb. 2017. Web. <https://www.eia.gov/consumption/residential/data/2015/hc/php/hc2.1.php>.

| Statistic | Inground | | Aboveground | | Commercial | |
|---------------------------------------|---------------|-----------|----------------|---------|----------------|--------|
| Total base - 2015 | 5,139,990 | | 3,394,565 | | 243,499 | |
| Units Sold/Installed 2014 | 58,000 | | 162,000 | | 2,432 | |
| Percentage Change 2013 | 4.4% | | -6.4% | | | |
| Top 10 States (Installed base, total) | California | 1,233,611 | California | 335,988 | California | 40,536 |
| | Florida | 1,027,846 | Texas | 266,785 | Florida | 24,774 |
| | Texas | 397,793 | Florida | 250,728 | Texas | 21,300 |
| | Arizona | 322,346 | Ohio | 151,738 | Arizona | 9,574 |
| | New York | 231,861 | Illinois | 148,537 | Ohio | 8,417 |
| | Ohio | 131,498 | New York | 143,566 | New York | 7,281 |
| | Pennsylvania | 129,776 | Pennsylvania | 139,629 | North Carolina | 7,020 |
| | Massachusetts | 124,225 | Michigan | 130,498 | New Jersey | 6,721 |
| | Illinois | 123,969 | Georgia | 114,601 | Georgia | 6,433 |
| | Virginia | 114,568 | North Carolina | 108,805 | Pennsylvania | 6,241 |
| Top 10 States (New units, 2011) | Florida | 16,392 | Texas | 15,712 | Not reported | |
| | California | 10,898 | California | 15,663 | | |
| | Texas | 6,979 | Florida | 14,387 | | |
| | Arizona | 3,882 | Georgia | 6,402 | | |
| | New York | 2,588 | New York | 6,350 | | |
| | Virginia | 1,511 | Illinois | 6,261 | | |
| | Massachusetts | 1,468 | Ohio | 5,842 | | |
| | Maryland | 1,349 | North Carolina | 5,679 | | |
| | Illinois | 1,201 | Pennsylvania | 5,319 | | |
| | Pennsylvania | 1,170 | Michigan | 4,701 | | |

Source: P.K. Data (2016A)³⁵

Figure 1. 2015 United States Pool Market

Pool installation is most closely related to new home construction, but while new housing construction has recovered in recent years, pool installation rates have not similarly rebounded. Figure 2 displays in-ground pool installations as well as single-family home monthly construction starts between 2007 and 2016. However, not shown in Figure 2, by the end of 2016, in-ground and above-ground pool construction posted more positive gains (P.K. Data 2017A³⁶).

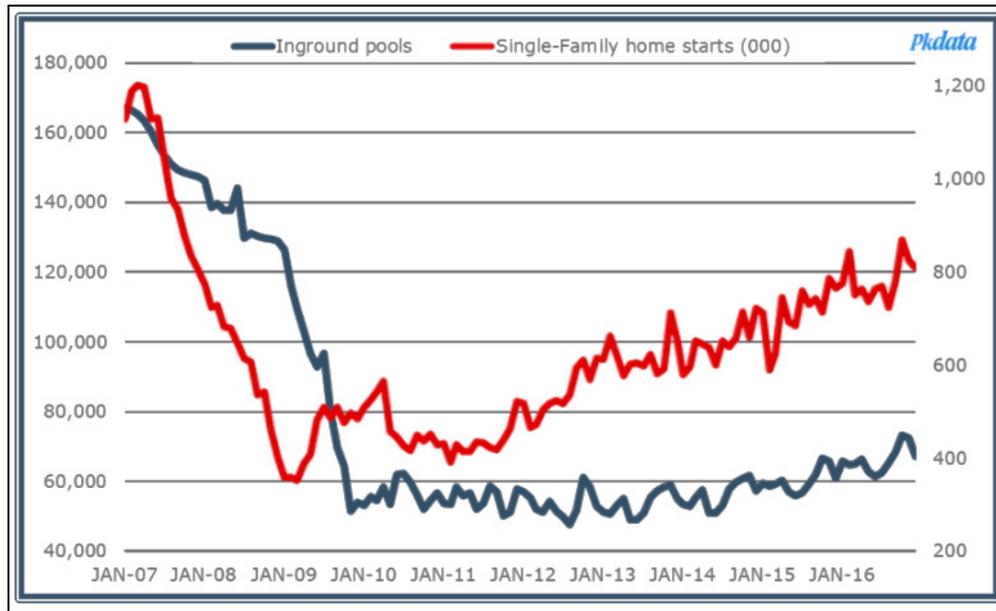
There have also been reports of pool decommissioning across the United States. Pool owners may choose to remove their pool for a variety of reasons, such as to reduce maintenance costs or to respond to regional water scarcity concerns. In 2016, Scottsdale, Arizona became the first municipality in the United States to offer a rebate for pool removal (AMWUA 2016³⁷).

WaterSense is seeking more recent data and input on the current market trends for pool installation and pool decommissioning.

³⁵ P.K. Data, Inc. 2016A, *op. cit.*

³⁶ "U.S. Residential Swimming Pool Market Year Ending 2016." *P. K. Data, Inc.*, 2017. Web. http://www.pkdata.com/uploads/3/4/6/7/34673690/ye_2016_us_residential_pool_report_tof.pdf

³⁷ Tenney, Warren. "Scottsdale Offers Arizona's First Pool Removal Rebate." *AMWUA.org*. Arizona Municipal Water Users Association (AMWUA), 29 Aug. 2016. Web. <http://www.amwua.org/blog/scottsdale-offers-arizonas-first-pool-removal-rebate>



Source: P.K. Data, Inc. (2017B)³⁸

Figure 2. Single-Family Housing Starts (thousands of units) versus In-ground Pool Construction Between 2007 and 2016 in the United States

Based on anecdotal evidence provided by some pool covers manufacturers and pool installers, WaterSense estimates between 10 and 25 percent of existing pools currently have a cover (AquaticNet 2009³⁹; Pooled Energy 2016⁴⁰). While WaterSense has not identified any recent data on the rates of pool cover ownership, anecdotal evidence suggests that pool cover ownership and use rates vary widely even among the ten states in Figure 1. A National Renewable Energy Laboratory (NREL) study conducted between 1998 and 1999 found that pool cover ownership and usage rates varied significantly among California, Arizona, and Florida; three states with vastly different climates. At that time, no pools in Arizona used pool covers, only one percent of pools in Florida used pool covers, and 13 percent of California pools used a cover (NREL 1999, as cited in National Resources Defense Council 2008⁴¹).

Purchase and installation costs of the various types of pool covers (e.g., solid, mesh, hybrid) or their control mechanisms (e.g., manual or automatic) may have an impact on application rates and water savings. Based on WaterSense product research, manually controlled pool covers typically retail between \$50 and \$350, with costs for cover storage or mechanisms such as reels

³⁸ "U.S. single family housing starts vs new in-ground pool construction." Digital image. *PKData.com*. P. K. Data, Inc., 2017. Web. <http://www.pkdata.com/chart-of-the-week.html>.

³⁹ "MEDIA: Statistics How Many Pools Are There in the U.S.?" *Aquaticnet.com*. Aquatic Resources Network, 2009. Web. <http://www.aquaticnet.com/media-statistics3.htm>

⁴⁰ Riedl, John. "The Pros and Cons of Swimming Pool Covers." *Pooled Energy*. Pooled Energy, 4 Apr. 2016. Web. <https://www.pooledenergy.com/blog/benefits-of-swimming-pool-covers/>

⁴¹ Synapse Infusion Group, *Report on Solar Pool Heating Quantitative Survey: August 1998-December 1998*, The National Renewable Energy Laboratory, NREL/SR-550-26485, April 1999, pp. 9, 20, 22; As Cited In: Rivera, Jeremy, Chris Calwell, Laura Moorefield, and Ecos Consulting. "Synergies in Swimming Pool Efficiency: How Much Can Be Saved?" *Scribd*. National Resources Defense Council (NRDC), 24 Mar. 2008. Web. <https://www.scribd.com/document/17720453/NRDC-Report-Synergies-in-Swimming-Pool-Efficiency>

and rollers, not included. Manually controlled pool covers with top-mounted tracks and their installation can cost up to \$6,000. Automatically controlled pool covers tend to be priced between \$5,000 and \$20,000, including the cost of installation. Certified safety covers typically cost between \$500 and \$2,000, not including the additional cost for installation or additional control mechanisms. **WaterSense is seeking data and input on the current ownership rates for different types of pool covers used with different control mechanisms and applied to different types of pools (e.g., in-ground and above-ground).**

V. Scope

Many of the aforementioned standards and test methodology provide definitions for terms describing various types of pool covers.

- *ASTM F1346-91* gives several definitions for types of pool covers, including:
 - Automatic cover—a cover which can be placed over the water area and removed with a motorized mechanism actuated by a suitable control mechanism.
 - Cover—something that covers, protects or shelters, or a combination thereof, a swimming pool, spa, or hot tub.
 - Manual cover—cover which requires it to be placed over the water area by hand.
 - Safety cover—a barrier (intended to be completely removed before entry of bathers), for swimming pools, spas, hot tubs or wading pools, attendant appurtenances and/or anchoring mechanisms which reduces—when properly labeled, installed, used and maintained in accordance with the manufacturers' published instructions—the risk of drowning of children under five years of age, by inhibiting their access to the contained body of water, and by providing for the removal of any substantially hazardous level of collected surface water (ASTM 2018⁴²).
- The only definitions given in *ISPSC* relevant to this discussion are for types of safety covers.
 - Power Safety Cover—a pool cover that is placed over the water area and is opened and closed with a motorized mechanism activated by a control switch.
 - Safety cover—a structure, fabric or assembly, along with attendant appurtenances and anchoring mechanisms, that is temporarily placed or installed over an entire pool, spa or hot tub and secured in place after all bathers are absent from the water (ICC 2018⁴³).

For the purpose of a draft specification, WaterSense intends to define a pool cover as “a cover which can be placed over the water area of a swimming pool and is intended for use during the open swim season.” This definition is consistent with the pool cover definitions included in *ASTM F1346-91* and *ISPSC*. When applied consistently and appropriately, covers can reduce evaporation of pool water and may trap heat inside the pool water, each of which contributes to water, energy, and cost savings for pool owners. Non-liquid pool covers are also capable of reducing debris from entering the pool water. WaterSense is considering excluding winter covers, as they are not intended for regular application, and therefore, are unlikely to be used in

⁴² ASTM 2018, *op. cit.*

⁴³ ICC, *op. cit.*

a manner to significantly reduce evaporation. **WaterSense is seeking input on this definition and intended scope of a specification. WaterSense would also be interested in other accepted industry or regulatory definitions, in addition to those discussed above.**

WaterSense does not intend to label companion products such as reels and rollers. **However, WaterSense would be interested in data and controlled studies on any companion products that directly impact the water efficiency and performance of pool covers.**

VI. Water Efficiency

Pool covers, through their use, inherently reduce evaporation of pool water, with the various aforementioned factors (e.g., material, material grade, pool setting) determining the magnitude of each cover's potential for reduced evaporation. However, any pool cover is only capable of reducing pool evaporation when properly and consistently applied to the swimming pool. While some data and methodologies are available to quantify the potential magnitude of an individual cover's ability to reduce evaporation, no methodologies exist that would provide accurate data on pool cover application rates in the real world. **WaterSense is seeking data on pool cover application rates to assess its impact on potential water savings. WaterSense is also interested in data that evidences certain configurations (e.g., control mechanism) that could impact these real-world application rates.**

As determined by the CalPoly study, different types of solid pool covers, when constantly applied, can reduce evaporation by approximately 95 percent. To be conservative and to potentially accommodate other pool cover models that were not involved in the CalPoly study, WaterSense is considering establishing criteria that would require pool covers to reduce evaporation by at least 80 percent, in comparison to the same open vessel, to be eligible for the WaterSense label. This value is consistent with Australia's *Smart WaterMark* program *Guidelines for Pool Cover Applications*. **WaterSense is seeking feedback from stakeholders on the reasonableness of establishing water efficiency criteria for pool covers to reduce evaporation by 80 percent.**

The aforementioned test method, *ASTM E96*, covers the determination of a water vapor transmission rate through a given material, defined as 'the steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface' (*ASTM 2016*⁴⁴). This may be measured through one of two given approaches, the Water Method or the Desiccant Method (*ASTM 2016*⁴⁵). Australia's voluntary *Smart WaterMark* program suggests that the Water Method is the most representative of conditions under which pool covers are used. For a pool cover to receive the *Smart WaterMark*, after testing, a product must be able to demonstrate minimum water savings of 80 percent compared with an equivalent, open water vessel (*Smart WaterMark 2010*⁴⁶). Variations for low and high humidity conditions are also provided for both methods. WaterSense is considering using *ASTM E96* to evaluate the rate of water vapor transmission through pool covers. **WaterSense is also interested in feedback from stakeholders regarding the**

⁴⁴ ASTM 2016, *op. cit.*

⁴⁵ ASTM 2016, *op. cit.*

⁴⁶ "Certification: Guidelines." *Smart Approved WaterMark*. Smart WaterMark, 2010. Web. https://smart-approved-watermark.s3.amazonaws.com/uploads/files/pool_cover_guidelines_2010.doc; <https://www.smartwatermark.org/apply-now/>

viability of using *ASTM E96* to assess a pool cover's efficacy in reducing water evaporation.

The methodology described in *ASTM E96* is intended to only gauge vapor transmission through a material that exhibits 100 percent coverage of the water surface. However, in some cases, a pool cover may not be able to cover the pool entirely. This may occur with the use of solar rings or in pools with irregular designs (e.g., pools with water slides, pools with disability access equipment). Typically, a sufficient quantity of solar rings so as to cover between 70 and 80 percent of the pool water surface is recommended (Pool Warehouse 2018⁴⁷; In The Swim 2018⁴⁸). The CalPoly study evaluated a set of solar rings that covered 73 percent of the water surface and reduced evaporation by roughly 50 percent (CalPoly 2016⁴⁹). These results indicate that the relationship between coverage and water savings is not an equivalent ratio, but rather may vary based on an unknown factor. **WaterSense is seeking information and data that describes this relationship between coverage and water savings. If data of this nature is unavailable, WaterSense would be interested on feedback on how to calculate a water savings factor for pool coverage.**

Estimated Water Losses

A range of factors complicate calculating the realized water savings derived from applying a pool cover to a particular pool. Pool cover type (i.e., liquid versus non-liquid), material grade (e.g., solid, mesh, hybrid), pool size and shape, as well as the local conditions to the pool, such as precipitation, evaporation rates, wind, and sunlight exposure, all impact the evaporation rate an individual pool will experience. This means the potential magnitude of water savings an individual pool owner could anticipate from purchasing a pool cover is acutely pool-specific. Also, as discussed, the true water savings an individual pool owner will experience through use of the pool cover relies entirely on the user's behavior, and thereby, the rate of cover application. While alarms and mobile phone applications exist to encourage and remind pool owners to cover their pools whenever they are not being used, there is no means by which to enforce pool cover application or to gauge users' behavior impact on realized water efficiencies. At this point in time, WaterSense does not have sufficient information to establish criteria or specification requirements that address the human element to ensure pool covers are consistently applied.

While such data are not available to discern how much water pool covers realistically save, WaterSense has used some of the aforementioned data sources to estimate the potential magnitude of water lost to evaporation from a typical pool under varying summer climates. As noted, 500 ft.² is roughly the average size of an in-ground residential pool (Koeller and Company and Hoffman and Associates 2010⁵⁰; WRF 2016⁵¹). Combining information given in Koeller and Company and Hoffman and Associates (2010)⁵² on average annual pan evaporation rates across the United States with the data from the APSP on pool ownership rates by state (P.K.

⁴⁷ "Solar Sun Rings." PoolWarehouse.com. Pool Warehouse. Web. 30 Aug. 2018.
<https://www.poolwarehouse.com/shop/solar-sun-ring>.

⁴⁸ "Solar Sun Rings for Swimming Pools." *InTheSwim.com*. In The Swim. Web. 30 Aug. 2018.
<http://www.intheswim.com/p/solar-sun-rings>

⁴⁹ CalPoly, *op. cit.*

⁵⁰ Koeller and Company and Hoffman and Associates, *op. cit.*

⁵¹ WRF, *op. cit.*

⁵² Koeller and Company and Hoffman and Associates, *op. cit.*

Data 2016A⁵³), WaterSense determined the expected magnitudes of water lost to evaporation from an individual pool under climates similar to the regions with the highest rates of pool ownership: the Southwest (average annual pan evaporation rate of 100 inches per year) and Northeast (average annual pan evaporation rate of 40 inches per year). These estimates are shown in Table 2. These water losses were then used to quantify the cost to a pool owner in terms of water utility costs, as well as energy utility costs for an owner of a heated pool (heated using either electricity or natural gas), and these estimates are shown in Table 3. As can be seen in Table 2, an average pool even in the colder of the two climates can lose more than 12,000 gallons of water a year to evaporation.

Table 2. Individual Pool Water Loss

| Pool Size | Pool Size | Annual Pan Evaporation Rate | Annual Water Loss to Evaporation | Annual Cost of Water Loss ⁵⁴ |
|-----------------|-----------------|-----------------------------|----------------------------------|---|
| ft ² | in ² | in/year | gal/year | -- |
| 500 | 72,000 | 40 | 12,000 | \$130 |
| 500 | 72,000 | 100 | 31,000 | \$340 |

Table 3. Energy Costs from Individual Pool Water Loss

| Pool Size | Pool Size | Annual Energy Loss | Annual Cost of Electricity Energy Loss ⁵⁵ | Annual Energy Loss | Annual Cost of Natural Gas Energy Loss ⁵⁶ |
|-----------------|-----------------|------------------------|--|------------------------|--|
| ft ² | in ² | kWh/year ⁵⁷ | -- | Mcf/year ⁵⁸ | -- |
| 500 | 72,000 | 32,000 | \$4,000 | 110 | \$1,000 |
| 500 | 72,000 | 81,000 | \$10,000 | 270 | \$2,700 |

VII. Performance and Product Testing

In addition to water efficiency testing, pool covers perform many additional services that may need to be addressed within a draft specification. In fact, most pool cover owners purchase their pool covers with these other features primarily in mind.

Most notably, pool covers may be certified as safety pool covers. Many states and jurisdictions have established safety requirements for the construction and maintenance of residential pools, often requiring the additional construction of a safety barrier. In most cases, pool owners are offered several options for acceptable safety barriers around their pool. These options often

⁵³ P.K. Data, Inc. 2016A, *op. cit.*

⁵⁴ (\$11.02 per Kgal Water & Wastewater (AWWA/RFC 2016)): American Water Works Association (AWWA), and Raftelis Financial Consultants, Inc. (RFC). *2016 Water and Wastewater Rate Survey*. Denver, CO: AWWA, 2017.

⁵⁵ (\$0.13 per kWh energy (EIA 2016)): "Short-Term Energy Outlook." *EIA.gov*. U.S. Energy Information Administration (EIA), 2016. Web.

⁵⁶ (\$10.06 per Mcf energy): EIA 2016, *op. cit.*

⁵⁷ The EPA estimates the energy lost through evaporation and that is required to reheat pool make-up water is equal to 2.61 kWh of electricity per gallon.

⁵⁸ The EPA estimates the energy lost through evaporation and that is required to reheat pool make-up water is equal to 0.008 Mcf of natural gas per gallon.

include the installation of a safety pool cover; installation of a locking fence or wall of a specified height around the pool perimeter; or installation of self-latching locks on all doors and access ways to the pool area. These barrier options are intended to reduce the risk of drowning of children and animals by inhibiting their access to pool water.

A safety pool cover is a cover that has been certified to meet the safety requirements established in *ASTM F1346-91*, including:

- a static load test to bear the weight of at least 485 lbs. for five minutes, long enough to permit a rescue operation;
- a perimeter deflection test to ensure no gaps over the pool water surface, through which a child or animal could fall, are formed when the cover bears a load; and
- a surface drainage test to ensure an average rainfall load will drain from the cover surface within 30 minutes (*ASTM 2018*⁵⁹).

If a pool cover meets the stipulated requirements, a safety pool cover may be made of any design, material, or material grade (e.g., solid, mesh, hybrid). While a pool cover may seem like the simplest option available since it minimizes physical construction, some pool owners may be unable to use a safety pool cover on their pool. Within the current market, safety covers tend to be within the higher end of the product price range and may require professional assistance to install. Moreover, some individuals, such as children or the elderly, may have trouble applying a safety pool cover, especially if it is manually controlled.

In addition to the water efficiency criteria discussed above, WaterSense is considering whether to require additional features, such as certification as a safety cover, in a draft specification given that these certifications may preclude some types of pool covers from water efficiency labeling. **The EPA is seeking input on whether WaterSense should require *ASTM F1346-91* certification as a safety pool cover as performance criteria in a draft specification.**

WaterSense frequently includes lifecycle testing of products to ensure water savings throughout the lifetime of the product. None of the aforementioned standards or test methods define a product lifespan; and the EPA is not aware of any existing test methodologies that assess this factor. **WaterSense is, therefore, seeking input on whether a lifecycle or other durability tests and criteria are necessary, and if so, if stakeholders have an appropriate definition of and expectation for lifespan. This would include units of measurement (e.g., years, number of uses) and a test methodology to assess the lifespan viability of the product.** With this lifespan, WaterSense may choose to establish testing limits that ensure at least 80 percent water savings from pool cover use upon both cover installation and the end of its useful life.

In general, pool covers typically keep debris out of the pool, reducing the use of energy-intensive pool equipment, such as pool filters and pool pumps, contributing to energy savings. Reduction in pool filtering rates can also contribute to additional water savings from reduced filter backwashing, which is a water-intensive process (Koeller and Company and Hoffman and Associates 2010⁶⁰). There are other performance benefits of pool covers that the EPA has evaluated and is also interested in hearing stakeholder feedback.

⁵⁹ *ASTM 2018, op. cit.*

⁶⁰ Koeller and Company and Hoffman and Associates, *op. cit.*

However, in some hot climates, pool covers can trap too much heat in the pool water, making it too warm for pool owners to swim in. Some of these pool owners may need to purchase a water feature, such as misters or a waterfall, or pool cooler, to correct the pool water temperature (ThoughtCo. 2018⁶¹). These additional installation and utility costs for these cooling features may outweigh any energy or water savings gains made through the application of the pool cover.

WaterSense is not aware of any other negative impacts (e.g., system impacts, impacts to users' health and safety) resulting from requiring the use of pool covers. **Are there any system impacts or impacts to user health and safety that would result from requiring the use of pool covers that WaterSense has not considered? WaterSense is also seeking input on whether there are additional factors to consider in product performance that should be addressed within a draft specification.**

VIII. Product Marking, Documentation, and Marketing

While *ASTM F1346-91* is most often referenced as the certification for safety covers, it also prescribes labeling requirements that apply to all solid pool covers; mainly requiring solid pool covers, and some packaging, be marked with appropriate manufacturer, warning, and safety labels. It also requires pool covers be labeled with a life expectancy but does not stipulate a limit or expectation. As discussed in **Technical Background**, many standards and codes defer to *ASTM F1346-91* for their labeling requirements (ASTM 2010⁶²).

There are no existing labeling requirements related to water efficiency from any standards or codes currently known to WaterSense. Nor is WaterSense aware of any product packaging that currently advertises pool cover water efficiency or ability to reduce evaporation. **WaterSense is seeking input on reasonable ways to mark products, product packaging, and associated documentation (e.g., specification sheets), and content with which to mark them, to indicate water efficiency benefits of pool covers.**

IX. Stakeholder Engagement

WaterSense has identified many utility rebate programs for pool covers offered by a range of water efficiency organizations and water utilities, largely within states with high rates of pool ownership. Within California, the Valencia Water Company and Castaic Lake Water Agency (CLWA) both offer rebates for pool cover purchases. Valencia Water Company offers \$75 for purchasing a regular pool cover and \$200 for purchasing a "permanent, mechanical pool cover," and these rebates are applied as credits to a pool owner's monthly utility bill (SCVTV 2015⁶³). CLWA offers up to \$200 for a pool cover for an in-ground pool that covers more than 85 percent of a pool (CLWA 2018⁶⁴). Outside of California, the Southern Nevada Water Authority (SNWA) offers \$50 or 50 percent, whichever is less, off the purchase price of a "manual use" pool cover or \$200 or 50 percent, whichever is less, off the purchase price of a "permanently installed,

⁶¹ McDowell, Woody. "How to Reduce the Temperature of Your Swimming Pool." *ThoughtCo*. Dotdash, 7 Apr. 2018. <https://www.thoughtco.com/cool-hot-swimming-pools-3169909>.

⁶² ASTM 2018, *op. cit*

⁶³ "Valencia Water Co. Offering Rebates for Pool Covers." *SCVNews.com*. SCVTV, 30 June 2015. Web. <https://scvnews.com/2015/06/30/valencia-water-co-offering-rebates-for-pool-covers/>

⁶⁴ "Residential Pool Cover Rebate." *SCV Water Conservation Programs*. SCV Water. Web. 2018. https://conservation.clwa.org/program/?content_id=77

mechanical pool cover" (SNWA 2018⁶⁵). Austin Water Utility in Austin, Texas hosts a similar program (Austin Water 2016⁶⁶).

WaterSense intends to develop a specification in part to draw attention to uncovered pools as sources of significant water loss and to promote water-efficient pool covers to utilities, home builders, pool professionals, and consumers. **WaterSense is seeking ideas for how to engage utilities and industry professionals on the best approaches to raise consumer awareness of pool covers and their impacts on water efficiency.**

X. Additional Considerations for Promoting Water-Efficient Pool Design and Operation

Pool covers are one of many influencers on total pool system water consumption, and pools present other opportunities for WaterSense to programmatically impact pool water waste. Solid pool covers help keep debris out of the pool, reducing cleaning needs, and thereby, reduce the operation of pool equipment such as pool filters. Reductions in pool filtering can contribute to additional water savings through a reduction in filter backwashing (Koeller and Company and Hoffman and Associates 2010⁶⁷). Thus, pool cover water efficiency may be evaluated in terms of reduced evaporation and reduced total pool system water consumption. By reducing evaporation, pool covers also reduce the operation of pool pumps, which represent 70 percent of the total energy used by swimming pool systems and typically represent the largest electrical end-use for a residential premise (Davis Energy Group 2004⁶⁸). Thus, pool covers can also make significant contributions to energy savings in addition to their contributions derived through trapping heat to minimize pool water heating costs (Koeller and Company and Hoffman and Associates 2010⁶⁹). **WaterSense would be interested in data on the impact pool cover application has on pool filter use and pool (re)filling rates as well as total pool system water and energy savings and the interplay of pool system components. WaterSense is also seeking input on whether there are additional factors to consider in pool system performance that should be addressed within a draft specification.**

In addition to pool covers, there are other influencers that may impact pool water consumption. These influencers include pool and landscape design, operation and maintenance procedures, and other pool equipment, such as pool filters. As such, WaterSense is considering developing other materials to promote water efficiency within the design, operation, and maintenance of pool systems. These efforts include examining opportunities to engage in pool professional training and certification, developing design guidance for water efficient pool systems, and potential specifications for other pool-related product categories, such as pool filters. A specification for pool covers would be just one tool by which WaterSense could promote water

⁶⁵ "Pool Cover Instant Rebate Coupon." *Southern Nevada Water Authority*. Southern Nevada Water Authority, Web. 2018. https://www.snwa.com/rebates/coupons_pool.html.

⁶⁶ "Pool Cover Residential Rebate." *The Official Website of Austin Texas*. Austin Water, 23 June 2016. Web. http://www.austintexas.gov/sites/default/files/files/Water/Conservation/Rebates_and_Programs/PoolCoverRebate.pdf.

⁶⁷ Koeller and Company and Hoffman and Associates, *op. cit.*

⁶⁸ "Analysis of Standards Options For Residential Pool Pumps, Motors, and Controls." *Codes and Standards Enhancement Initiative For PY2004: Title 20 Standards Development, Florida State University Consensus Center*. Davis Energy Group, 12 May 2004. Web. http://www.consensus.fsu.edu/FBC/Pool-Efficiency/CASE_Pool_Pump.pdf.

⁶⁹ Koeller and Company and Hoffman and Associates, *op. cit.*

efficiency of pools. **WaterSense requests feedback from stakeholders on whether there is perceived or potential interest in these potential program areas.**

XI. Summary of Information Requests

WaterSense is requesting feedback on all aspects of this notice; summarized below are the specific outstanding issues, questions, and concerns about which WaterSense is seeking input on prior to drafting its specification for pool covers. All interested parties are encouraged to submit information and comments to watersense-products@epa.gov.

Technical Background

- Are additional standards, codes, or test methodologies available that specifically require pool cover use or address pool cover water efficiency or performance?

Existing Studies

- Are data on application rates of pool covers in real-world scenarios available?
- What impact, if any, can control mechanisms impart on application rates of pool covers in real-world scenarios?

Product Market

- Are recent data available on the current market trends for pool installation and pool decommissioning?
- Are data available on the current ownership rates for different types of pool covers used with different control mechanisms and/or applied to different types of pools (e.g., in-ground and above-ground)?

Scope

- WaterSense intends to define a pool cover as a cover which can be placed over the water area of a swimming pool and is intended for use during the open swim season. Is this definition and scope appropriate and sufficient for use in a draft specification?
- Are there any accepted industry or regulatory definitions in addition to those discussed previously of which WaterSense should be aware?
- Are there any companion products that directly impact the water efficiency and/or performance of pool covers?

Water Efficiency

- WaterSense intends to establish water efficiency criteria for pool covers to reduce evaporation at 80 percent. Is this limit reasonable?
- Is the ASTM E96 test method sufficient for evaluating pool cover water efficiency?

- Are information and data that describe the relationship between percent coverage of pool water surface and produced water savings available? How could WaterSense calculate a water savings factor for pool coverage?

Performance and Product Testing

- Should WaterSense require *ASTM F1346-91* certification as a safety pool cover as performance criteria in a draft specification?
- Is there an industry accepted definition of a pool cover lifespan and/or units of measurement (e.g., years, number of uses) for solid pool covers of all types? Are there any test methodologies or durability tests that evaluate pool cover or similar product lifespan?
- Are there any system impacts or impacts to user health and safety that would result from requiring the use of solid pool covers that WaterSense has not considered?
- Are there any additional factors to consider in product performance that should be addressed within a draft specification?

Product Marking, Documentation, and Marketing

- What are reasonable ways to mark products, product packaging, and associated documentation, and content with which to mark them to indicate water efficiency benefits of pool covers?

Stakeholder Engagement

- How can WaterSense engage utilities and plumbing professionals in the best approaches to raise consumer awareness of pool covers and their impacts on water efficiency?

Additional Considerations for Promoting Water-Efficient Pool Design and Operation

- Are data available on the impact pool cover application has on pool filter use and pool (re)filling rates, or on total pool system water savings and the interplay of pool system components?
- Are there are additional factors in pool system performance resulting from pool cover application that should be addressed within a draft specification?
- Are stakeholders potentially interested in possible program areas, such as professional certification or pool system design guides?

XII. Schedule and Next Steps

WaterSense is requesting input, supporting information, and data from all interested parties on topics discussed in this NOI and otherwise related to pool covers. Interested parties can provide input to WaterSense regarding any of the issues presented in this notice by submitting written

comments to watersense-products@erg.com. Comments and information on the issues presented in this NOI are welcome and will be taken into consideration as WaterSense considers development of a draft specification for pool covers.

WaterSense will accept feedback on the information requested above and will consider all comments and information provided by stakeholders and the general public. In addition, WaterSense will hold a public meeting to discuss the information presented in this NOI and any stakeholder feedback received as part of the NOI review. The release of a draft specification will be contingent upon adequate resolution of the questions and issues presented in this NOI.

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